

# CLAIMS

I claim:

1. A fail-safe engine cooling control system for a hybrid electric vehicle (HEV) when the engine temperature exceeds a predetermined calibratable level comprising:

An electric traction motor;

An engine;

An Engine temperature sensor;

A system to cool the engine, whereby safe and efficient engine operating temperatures are maintained;

A Vehicle System Controller;

A fail-safe system to assure that in the event the system to cool the engine fails, acceptable engine temperatures are maintained while vehicle operating range is extended, adequate power is provided to the vehicle, and noise, vibration and harshness (NVH) is kept to a minimum.

2. The fail-safe cooling system of claim 1, wherein adequate power to the vehicle is limited to half its normal operating power.

3. The fail-safe cooling system of claim 1, further comprising a determination of whether to halt engine operation and rely on the power output of the electric traction motor.

4. The fail-safe cooling system of claim 1, wherein NVH is kept to a minimum by not allowing the HEV to operate in a parallel mode, whereby the generator used to reduce torque pulses from the engine.

5. The fail-safe cooling system of claim 1, further comprising at least one engine compartment cooling fan controlled to an optimal speed to minimize electrical load while maximizing air circulation based on vehicle speed and engine temperature.

6. The fail-safe cooling system of claim 2, whereby engine power is reduced to half its normal operating power by a fuel cut method to one or more cylinders in an alternating fashion.

7. The fail-safe cooling system of claim 3, wherein the determination to halt engine operation is based on driver demand, vehicle speed, battery state of charge, or air conditioning requests.

8. A fail-safe engine cooling control method for a hybrid electric vehicle (HEV) when engine temperature exceeds a predetermined calibratable level comprising the steps of:

Sensing Engine temperature;  
Cooling the engine, whereby safe and efficient engine  
operating temperatures are maintained;  
Controlling Vehicle systems; and  
5 Assuring through a fail-safe system that in the event the  
system to cool the engine fails, comprising the steps of  
maintaining acceptable engine temperatures, extending  
vehicle operating range, powering the vehicle adequately,  
and minimizing noise, vibration and harshness (NVH).

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9. The fail-safe cooling method of claim 8, wherein powering  
the vehicle adequately comprises limiting the engine to  
half its normal operating power.

15 10. The fail-safe cooling method of claim 8, further  
comprising the step of determining whether to halt engine  
operation and rely on the power output of the electric  
traction motor.

20 11. The fail-safe cooling method of claim 8, wherein the step  
of minimizing NVH is achieved by prohibiting the HEV to  
operate in a parallel mode, whereby fixing a generator  
speed to a zero is prohibited.

12. The fail-safe cooling method of claim 8, further comprising the step of controlling at least one engine compartment cooling fan to an optimal speed minimizing electrical load while maximizing air circulation based on vehicle speed and engine temperature.

13. The fail-safe cooling method of claim 9, whereby powering the vehicle adequately is limited to reducing the engine to half its normal operating power by a cutting fuel to half the cylinders in an alternating fashion.

14. The fail-safe cooling method of claim 10, wherein determining whether to halt engine operation is based on driver demand, vehicle speed, battery state of charge, or air conditioning requests.